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(54) Natural carob fibre and a procedure for its production.

(57) A natural carob fibre and a procedure for its production. The fibre comprises 50-65 % lignin, 15-25 % cellulose, 15-25 % hemicellulose, 0.5-2 % pectin, 3-7 % tannins and 4-8 % moisture. The procedure comprises the pressing of the waste pulp obtained in the operation of extracting the sugars from carob pulp.

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The present invention relates to a new natural product derived from the carob, and which corresponds to the water insoluble fraction of the pulp obtained after eliminating all the water soluble material, followed by drying and grinding to the granulometry corresponding to each market and use.

More particularly, the invention relates to a new natural carob fibre (NCF) and a procedure for its production.

The field of application of the invention corresponds to the dietetics sector and the human food sector.

BACKGROUND OF THE INVENTION

The fibres currently on the market are obtained mainly from cereals and are applied both to the field of dietetics and that of human food.

The effects which fibre has on the diet are well known in the field of nutrition. Equally well recognized is the lack of fibre in modern diets due to changes in traditional dietary customs. Equally well known is the influence which fibre has on the capture of fats in the intestine. Furthermore, the relationship between lipaemia and the ingesta of fat is generally accepted nowadays, as is its relationship to cardiovascular morbidity and mortality whilst within this ingesta the cholesterol content and the type of fat in the diet are clear risk factors.

DESCRIPTION OF THE INVENTION

The NCF fibre according to the present invention provides the market with a new product which, since it has the same nutritional characteristics as currently known fibres, practically duplicates the hypocholesterolaemiant effect, enabling the consequences of modern cholesterol-rich diets to be partially counteracted.

The patent application by the same applying Entity, presented on the same date and entitled "A syrup consisting of the natural carob sugars and a process for its production", describes and claims a new process for extracting and purifying the juice derived from the carob pulp to obtain on the one hand a natural syrup of the carob sugars and on the other a waste pulp which contains the insoluble fraction of the carob pulp.

The object of the present invention is to provide a new process which, starting the above mentioned waste pulp, enables a new natural carob fibre (NCF) to be obtained.

Therefore, according to a first aspect, the invention relates to a new process for obtaining said natural carob fibre and consists of the following phases:

1. CLEANING THE CAROB

The fruit from the fields is normally accompanied by a series of foreign elements such as stones, twigs, metallic elements, as well as the earth which sticks to the carob particularly if it was harvested during a rainy period.

The first operation consists of cleaning the carob of all of these additional elements by separating said foreign elements mechanically, cleaning the carob with water and drying to obtain the clean fruit, free of other material such that it is hygienically ready to go on to the cutting up phase.

2. CUTTING UP

Taking advantage of the fragility of the carob and the hardness of the seed (Garrofin), it is passed through a hammer mill where the pod is cut up sufficiently to release the seed. In practice, it is crushed until it passes through a perforated sheet sieve, with a hole diameter of 12 to 20 mm, situated inside the mill.

This phase produces a raw material which fulfils the conditions of hygiene required for food, something which is completely impossible when using the cut up product currently on the market since, because of its traditional use as an ingredient of mixed feed, current installations do not fulfil the minimum sanitary requirements.

3. CLASSIFICATION

The cut up material obtained from the crushing mill is fed continuously into a separator-sieve which consists of various sieves which separate on the one hand the garrofin and on the other the pulp according to whether the particles are inferior or equal/superior in size to the garrofin. This last fraction is re-fed to the mill in order to obtain a granulometry of less than 10 mm.

A high granulometry prevents a good yield from being obtained in the following phase of diffusion. The considerable formation of flour would obstruct the diffusion process and cause clogging problems.

A particle size of about 5/6 mm has to be aimed for, with the minimum formation of flour. Obviously the behaviour of the fruit during the mechanical process will be different depending on the humidity and agronomic variety, which implies the need for different adjustments.

4. EXTRACTION

The carob pulp, cut up to the appropriate granulometry, is fed into a continuous extraction machine.

The output from this machine is a raw juice, dark brown in colour, sweet with a bitter aftertaste and with

the characteristic odour of carob. The other output produces a waste pulp soaked in water which contains the insoluble fraction of the carob pulp.

The working conditions in this phase are:

Contact time: The pulp and the diffusion water must be in contact for the minimum amount of time necessary, in order to avoid the proliferation of micro-organisms and their corresponding infections. The contact time is between 1 and 3 hours depending on the variety and humidity content.

The temperature is between 15 and 30 degrees centigrade.

The working pH is between 4.6 and 5.4, independently of the pH of the water supply.

The output concentration is between 30 and 50 °BRIX. Concentrations of less than 30 °BRIX are not advisable because of profitability in the evaporation stage, nor are concentrations greater than 50 °BRIX recommended due to problems in the filtration process and the passage through the demineralization columns.

5. PRESSING OF WASTE PULP

When the pulps come out of the diffusor their water content is very high: 70 - 80 %, i.e. 30 - 20 % Dry Matter. It is essential to press these pulps before they are used in any way.

The pressing process enables a considerable proportion of the water carried by the pulps to be extracted mechanically, said water still containing in solution sugars and various non-sugars. This water is used for extracting the sugars in the previous stage, thereby achieving a considerable saving in water and avoiding undesirable wastage.

An efficient pressing process reduces the water content to 50 - 60 %. i.e. 50 - 40 % dry matter. The water recovered by this procedure may form 37 - 47 % of that carried by the pulp in the diffusion phase.

This operation is carried out using vertical or horizontal double or single helix continuous presses.

The working conditions in this phase are:

Drip time: This depends on the type of press. The pressing temperature is related to the diffusion output, although considering that the lower the temperature the higher the dynamic viscosity of the pressing water, it is not beneficial to store between the two operations. A pH of between 6 and 5 can be considered as the optimum value.

6. BREAKING UP

The greater the pressure exerted on the fibre during the pressing operation the greater the consistency of the fibre obtained as a result, making it difficult to eliminate the moisture which it contains. In order to dry the fibre properly the pressed retort has to be broken up. This is carried out by passing it continuously over a special mill which breaks it up leaving it in a state in which it can be dried.

The Working conditions in this phase are:

Time: instantaneous and continuous.

Room temperature.

7. DRYING

The moist fibre from the breaking up process is subjected to a drying process to eliminate all excess moisture. This process is carried out in forced hot air current ovens and is followed by cooling down to room temperature.

After the process, the fibre should have a moisture content of less than 5% in order that the grinding process can be carried out under good conditions.

Apart from eliminating the excess water, this operation also eliminates a series of volatile, unanalyzed substances which deodorize the fibre.

The Working conditions in this phase are:

Drying time: depends on the initial moisture content until a reduction to < 5%.

Temperature: 120 + 10°C

8. GRINDING

The dry fibre is converted into a flour by means of a traditional grinding process.

The Working conditions are:

Granulometry: between 50 and 250 mesh (ASTM E11-70).

9. SIEVING

The flour from the mills is sieved according to the various granulometries using industrial sieving equipment. Under normal conditions the rejected material is re-fed to the grinding operation where it re-enters the circuit.

The suitably sized fibre is packed in sacks or stored and is ready for distribution.

The accompanying drawing illustrates schematically the process of the invention.

Having described the process of the present invention it only remains to be said that during the course of said process other products are obtained. In phase 3 garrofin is also produced, in phase 4 the raw syrup is produced and in phase 5 the liquid obtained from the pressing process is used in the process of diffusion of the soluble fraction in operation 4.

Consequently, and according to another aspect of the invention, it provides a natural carob fibre (NCF) which is characterized in that it has the following composition:

Lignin	50-65 %
Cellulose	15-25 %
Hemicellulose	15-25 %
Pectin	0.5- 2 %
Tannins	3- 7 %
Moisture	4- 8 %

where the percentages are expressed in weight and are within certain limits depending on the fruit (variety, harvest, agricultural land, etc.), except for the moisture which depends on the applications.

The product of the invention is distinguished not only by the above mentioned composition but also by the following characteristics:

Physical characteristics:

A flour of varying particle size between 5 and 230 mesh (ASTM E11-70) or 4 and 0.063 mm (DIN 4188) depending on applications and uses. Brown, odourless and completely tasteless.

Nutritional characteristics: According to the results of the research work carried out, the nutritional behaviour of the fibre compared to the standard (microcrystalline cellulose) is similar in every aspect except that it produces a reduction in the assimilation of fat and that the NCF also has a significant hypocholesterolaemiant effect.

Microbiological characteristics:

It is a practically inert in the development of microorganisms due to its low moisture content.

In order to determine the nutritional behaviour of this fibre, and given that there is no specific technical documentation, a series of research experiments were carried out the aims and results of which are as follows:

First of all the behaviour of the NCF fibre was determined in terms of a number of parameters related to the nutritional exploitation of the diet: ingesta, increase in weight, alimentary efficiency coefficient (AEC) and protein and lipid digestibility.

In normal diets no difference was found between standard fibre (cellulose) and NCF fibre in terms of ingesta, increase in weight, alimentary efficiency coefficient (AEC). A reduction was observed however in the Fat Digestibility Coefficient (FDC) due to an increase in the amount of fat eliminated as faeces.

Once it was confirmed that the NCF fibre had not only no negative nutritional effect compared with standard fibre (microcrystalline cellulose), but that it added a difference in the behaviour relating to fat absorption, a second stage of tests was carried out, again using growing "Wistar" rats, in order to confirm and expand on the previous results. The conclusions drawn from this stage can be summarized as follows:

Independently of the level of fat in the diet, the NCF fibre significantly reduces the increase in weight of animals per gram of material ingested.

Compared to diets containing cellulose the NCF fibre significantly reduces the absorption of protein but without negative metabolic consequences, since the blocking of amino acid absorption does not appear to be selective on any essential amino acid.

Independently of the lipid content, the absorption of fat in a diet containing NCF fibre is also reduced compared to the control diets containing cellulose.

Under the experimental conditions the NCF fibre has no negative influence on the absorption of the minerals iron and zinc.

The hepatic deposits of liposoluble vitamins studied, retinol and vitamin E, were not significantly affected in the diets containing NCF compared to the control diets.

The physiological effect produced by the carob pulp was further explored and confirmed in the third stage, said effect producing a significant and important reduction in cholesterolaemia in diets with a high esterol content. Furthermore, it was also confirmed that the NCF fibre did not act in the way described above in the case of rats fed with normal diets.

To do this, four different, isocaloric diets were prepared, adapted to the requirements of the growing rat and in which the only variables were:

1. Dietary fibre. (5%)
   a.- Cellulose.
   b.- NCF fibre
2. Cholesterol ingesta
   a.- Diet without cholesterol
   b.- Diet high in cholesterol (2%)

These diets were fed for 28 days to four groups each containing ten rats born on the same day, checking the ingesta on a daily basis. The following parameters were determined individually for each of the four groups:

- Ingesta
- Increase in weight
- Seric cholesterol

The results were statistically treated to establish a level of significance of p ¾ 0.05, confirming the previous results:

- There are no differences between the two types of fibre in terms of ingesta and increase in weight.
- The increase of seric cholesterol in rats subjected to a high cholesterol diet is, in a group fed with a NCF diet, approximately half that of a group subjected to diets containing the control fibre (microcrystalline cellulose).
- This effect was not exhibited in normolitemic rats.

Claims

1. A natural carob fibre with hypocholesterolaemiant properties characterized in that it has the following composition:

Lignin	50-65 %
Cellulose	15-25 %
Hemicellulose	15-25 %
Pectin	0.5-2 %
Tannins	3-7 %
Moisture	4-8 %

where the percentages are expressed in weight and are within certain limits depending on the fruit (variety, harvest, agricultural land, etc.), except for the moisture which depends on the applications.

2. A process for obtaining the natural carob fibre according to claim 1, characterized in that it comprises the following stages:
   a) The fruit from the field is subjected to mechanical operations to separate the foreign elements, it is washed in water and dried by a current of air;
   b) The pods are cut up sufficiently to release the seed, preferably until they pass through a sieve with a hole diameter of 12 to 20 mm;
   c) The cut up material obtained in the previous stage is subjected to a separation-sieving operation to separate on the one hand the seeds and on the other the pulp, said pulp being subjected to classification, preferably until it has a granulometry of less than 10 mm.
   d) The pulp, cut up to the appropriate granulometry, is subjected to a continuous extraction process in which the pulp is put in contact with the diffusion water for the minimum amount of time necessary, in order to avoid the proliferation of microorganisms, to obtain on the one hand a raw juice, with a concentration of between 30 and 50 °Brix, and on the other a pulp which constitutes the insoluble fraction of the carob pulp.
   e) The waste pulp is pressed in order to extract a substantial part of the water it carries, said water still containing in solution sugars and various non-sugars and being recycled for the extraction of sugars in the previous stage;
   f) The fibre obtained in the pressing stage is broken up by passing it over a mill which leaves it loose;
   g) The moist fibre is dried until its water content is less than 5%;
   h) The dry fibre is ground into a flour with a granulometry of between 50 and 250 mesh (ASTM E11-70); and
   i) The flour is sieved ready to be packed, the rejected material being re-fed to the grinding operation.

3. A process according to claim 2, cbaracterized in that during the extraction process of stage d), the time for which the pulp remains in contact with the diffusion water is 1 to 3 hours, at a temperature of 15 to 30°C and at a pH of between 4.6 and 5.4.

4. A process according to claim 2, characterized in that during the pressing process of stage e), the pH is maintained between 5 and 6.

5. A process according to claim 2, characterized in that the process of stage f) is carried out at room temperature.

6. A process according to claim 2, characterized in that stage g) is carried out at temperatures of 120 + 10°C.

7. The use of the natural carob fibre according to claim 1 in dietetic and food applications.

8. The use of the carob fruit for obtaining the natural fibre according to the procedure in claims 2 to 6.

MATERIALS DIAGRAM